Meeting California's Greenhouse Gas Reduction Goals

Remarks of Michael R. Peevey, President

California Public Utilities Commission

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Good afternoon everyone. What I'd like to cover is a retrospective look at steps California has taken to reduce GHG emissions and a prospective look at the leaps we must take to reach our ambitious 2020 and 2050 goals. As I do so, I'll try to weave together some themes, such as technology paths to a low-carbon future and transforming the energy business.

This month marks my tenth year on the Commission so I'll start by giving you some perspective on how much GHG mitigation progress has happened over that time. There are three particularly significant policy developments that have occurred. Energy efficiency programs have been a part of utility practice in California dating back to the 1970s. In the past ten

years, however, the PUC has increased the magnitude of our energy efficiency efforts to an unparalleled degree. When I joined the PUC in 2002, the electric and gas utilities spent $300 million dollars that year on energy efficiency programs. The other commissioners and I believed that the utilities could do much more, and in 2006, we added an additional surcharge to supplement the public goods charge that had been authorized by the legislature. By 2008, the utilities were spending $1 billion per year and expenditures have since stabilized at roughly that amount.

How much energy efficiency does $1 billion a year buy?. A lot. Utilities will save nearly 4 million MWh of electricity and 60 million therms of natural gas per year from measures installed in 2010, up from 1.7 million MWh and 32 million therms from measures installed in 2002. Total cumulative savings, including previous investments in electric energy efficiency, are now saving 20 million MWh per year. These are impressive accomplishments, but I am convinced that there is still considerable room for improvement.

Perhaps the most important new energy policy that California has adopted in the last ten years is the renewable

portfolio standard. The first RPS statute was enacted a few months after I was appointed. The original law set a goal of reaching a 20% share of renewable energy by 2017. In 2006, the legislature, with the support of the PUC, accelerated the 20% goal to 2010. We didn't quite make that target, but I give the utilities some credit for making a good faith effort. To be honest, neither the PUC nor the ISO were fully prepared for the surge in project activity, and delays in moving projects through the process occurred at both agencies. Despite these growing pains, the investor-owned utilities had an average renewable share of nearly 18% by 2010, up from 14% at the start of the program. Stated that way, it may not sound like much, but renewable generation actually increased by 40% between 2002 and 2010 with nearly all of the growth occurring since 2006. And now each IOU is over 20%.

The strides we've made in reducing energy consumption and cleaning up the power supply translate into hefty GHG savings. As a rough estimate, PUC staff calculates that avoided GHG emissions in 2010 equaled 10 million metric tons of CO2, or a reduction of more than 10% of the business as usual emissions that would have occurred without the energy efficiency and RPS programs.

The other major policy milestone from the last decade that will profoundly affect the energy business is, of course, AB 32. I am an ardent supporter of cap and trade, and I initiated a proceeding at the CPUC to implement a cap and trade program for the electric utilities. Cap and trade is a powerful regulatory tool that serves as both a source of low-cost GHG reductions and a backstop to the other GHG mitigation policies that the state has adopted.

In implementing cap and trade, the Air Resources Board opted to largely follow the joint recommendation of the PUC and CEC by allocating the allowances to the electric utilities rather than to the generators. In our restructured market, we felt it was critical to keep the allowance value with the utilities, where the Commission can ensure that it is used for customer benefit, rather than allocated to the generators where it would have simply boosted their profits, as we saw in the European Union. The investor-owned utilities are required to auction their allowances on consignment in ARB's central auction, with the revenues to be deposited in the utilities' accounts.

I am the assigned commissioner for the proceeding that will determine how the revenues from the auctions should be used.

The stakes are substantial. The investor-owned electric utilities will receive roughly 65 million allowances in 2013. If the auction clears at ARB's floor price of a little over $10, more than $650 million dollars will pour into the utilities' accounts from the allowance sales, with a similar increase expected in expenditures for wholesale electricity. Futures for California allowances have been trading in a narrow range around $15, which, if accurate, would push the annual revenues flowing to the utilities closer to $1 billion.

The proposed decision is scheduled for release in June so the details will not be available until then. But I can tell you that in broad terms, I propose using most of the revenues for lump-sum rebates to residential customers. The utilities have argued that the revenues should be used to reduce rates – essentially to negate the pass-through of the cost of carbon in retail rates. I oppose that idea. Retail customers should receive information based on carbon prices about the environmental cost that their consumption of energy imposes. A much smaller share of the revenues will be directed to output-based rebates to emission-intensive, trade-exposed, or EITE, industries to compensate them for the indirect carbon costs they will bear in industrial electricity rates. These rebates will complement the output-based allocation

of allowances that ARB will provide to EITE firms based on each sector's on-site GHG emissions. Lastly, I will propose that a relatively small amount be reserved for AB 32 related measures.

Looking out to 2020, I think we are on target to reach California's GHG goals. Many of you are no doubt aware that last year the legislature raised the RPS goal to 33% by 2020. All of the IOUs have enough renewable generation under contract, even assuming a contract failure rate of 40%, to reach the intermediate goal of 25% during the 2014 – 2016 RPS compliance period. In 2020, assuming the utilities meet the 33% goal, the total new renewable generation from the RPS program will climb to 40 million MWh equating to approximately 12 million metric tons of avoided GHG emissions.

These targets can be met, relatively easily, by the primary renewable technologies that dominate the market today – solar PV and wind. But the intermittency of these technologies poses operational problems for the grid at high penetration levels. Integrating intermittent technologies requires the use of flexible capacity such as fast-ramping gas fired turbines or storage, which imposes additional cost on grid operations.

In order to ensure some technology diversity, we have encouraged the utilities not to put all of their RPS eggs in the wind and PV baskets. Solar thermal electric generation in particular has received substantial support from California utilities. As of now, the PUC has approved over 2,700 MW of solar thermal capacity and another contract for 1,200 MW is pending approval. These projects generate electricity using steam turbines, whose system inertia inherently provides a more stable output profile than PV. Moreover, some of these projects are designed with molten salt storage capacity enabling them to shift generation by several hours to better match system peaks.

When you look further into the future and consider the revolution in energy technologies that will be required to meet the 2050 goal of reducing emissions by 80% below 1990 levels, you can easily feel overwhelmed. California's population is projected to reach 55 million or more by then and per capita incomes will continue to rise. In short, there will be tremendous demand growth for energy services. At the same time, to reach the 2050 goal, emissions must fall from 470 million metric tons today to just 85 million metric tons despite the growth in population and incomes. It is clear that in such a scenario, fossil fuel consumption must be reserved only for the most critical uses.

The enormity of the decarbonization task is mind-boggling. Where do we even begin? Any concerted effort to reach that goal must entail a radical transformation of the way we produce electricity and steep efficiency gains in natural gas and electric end uses.

In January, the journal *Science* published a thought-provoking study by the consulting firm E3 and researchers affiliated with UC and LBNL that examines one possible scenario for California to reach the 2050 goal. In that scenario, three types of measures related to natural gas and electricity supplies account for 70% of the emission reductions below the business as usual baseline. The measures are electricity decarbonization, electric and natural gas energy efficiency, and electrification of additional end uses. Since natural gas energy efficiency only accounts for 10% of the 2050 reductions in E3's scenario, I'll focus on the 60% of the reductions from electricity-related measures. Among the general categories of reduction measures, electricity decarbonization provides the largest source of reductions. Under E3's scenario, the average emission intensity of electricity in the state must fall from the current statewide average of over 400 kg CO2 per MWh to about 25 kgCO2 per MWh. In other words, virtually all electricity must be generated

by renewables, nuclear or fossil fuels with carbon capture and sequestration.

As I said earlier, California's investor-owned utilities are on track to meet the 33% RPS target. Most of that will be met with technologies that are widely commercially available today, but I believe that we will probably have to go beyond those technologies to reach the 2050 goal. Let me digress for a moment to address concerns about the cost of supporting cutting edge technologies. I'm sure many of you have heard that if California were a country, it would have the seventh largest economy in the world. What is less often mentioned is that if you exclude countries with populations of less than a million, if California were a country it would have the 4th highest income per capita. As one of the wealthiest jurisdictions in the world, I believe that California has a responsibility to take chances on technologies that are not necessarily the lowest-cost GHG mitigation options available today, but that have game-changing potential in the long-term. There are two in particular that I would like to discuss.

Many people believe that carbon capture and sequestration must play a large role in decarbonizing electricity supplies. I am

not sure that California that can reach the 2050 goal without some CCS. Even if it could, California is particularly blessed with a wide range of high-quality renewable resources including substantial geothermal potential in the southeastern area of the state, pockets of high-quality wind potential, biomass and large areas with some of the highest solar energy density in the U.S. Other states and countries do not have these resources to draw on, and China, Russia and India are sitting on enormous coal reserves that they will use to grow their economies. Thus, it appears almost certain that if we're going to significantly reduce GHG emissions worldwide, CCS or nuclear energy, or both, will supply a significant share of the world's energy.

Although several commercial-scale CCS electricity projects have been proposed, only two have reached the final investment decision phase, a 110 MW coal-fired plant in Saskatchewan and a 582 MW coal-fired plant in Mississippi. California is home to one of the other leading sites poised to make it across the finish line. I'm sure most of you have heard of the Hydrogen Energy California, or HECA, project. As originally conceived, HECA would gasify petroleum coke, a refinery waste fuel, and then combust hydrogen in a highly efficient combined cycle power plant while using the carbon dioxide for enhanced oil recovery. The DOE has

awarded over $400 million to support the project, but on the condition that it use coal for at least 75% of the fuel input. The DOE is naturally interested in testing the technology with a high share of coal to ensure that it is replicable to other sites across the U.S. I am a little ambivalent about importing coal into California for the sake of demonstrating CCS technology, however, I am cognizant of the need for additional commercial scale applications to advance CCS technology and prove its viability.

This project was recently purchased from BP and Rio Tinto, the original project developers, by SCS Energy, a firm that specializes in technically challenging generation projects. They have developed an innovative business model that improves the economic viability of the project. SCS intends to use a large share of the hydrogen output from the gasification process to produce urea for fertilizer production. SCS intends to ramp the facility to produce more electricity during peak hours in order to maximize the energy and capacity value of the plant. This is an example of the kind of creative thinking we will need to solve the climate crisis.

Even if HECA ultimately fails to materialize, another viable CCS project is gaining some traction. This project would employ pre-combustion CCS with gas-fired generation, which is more relevant to California's electricity supply. Other interesting CCS developments are also afoot. Recently, a group of entrepreneurs came to California to brief me on a novel CCS technology that they claim achieves much higher efficiency than other coal combustion technologies and higher rates of carbon capture by using carbon dioxide instead of air as the working fluid. I'm not really sure what that means. I only know that coffee is my working fluid. I suppose my resting fluid is a good pinot. But anyway, I'm getting off track.

In addition to CCS, another technology that I am interested in is space-based solar. This technology works by launching PV modules into orbit and transmitting energy back to a receiving station on the earth's surface using microwave radiation. Although this sounds like science fiction, I am hopeful that recent advances in thinner, lighter-weight solar modules will make this technology feasible. In fact, the Commission has already approved a contract between PG&E and a start-up called Solaren that hopes to become the first company to make this technology a reality. The contract calls for Solaren to construct a receiving

station that will convert enough microwave radiation from orbiting solar panels to provide 200 MW of capacity. Although it is expensive to launch the necessary materials into orbit, a space-based system is capable of producing four or five times as much energy as a comparable amount of fixed-axis solar PV because it provides steady baseload power, 24 – 7. That baseload generation profile also means that space-based solar does not pose the grid integration and reliability problems that standard PV does. I believe it is worth taking a chance on this technology because as a baseload resource, space-based solar may help to displace coal-fired capacity that would otherwise meet those needs. Of course, I'm realistic enough to realize that this technology faces substantial technological hurdles.

I'd like to briefly discuss the importance of energy efficiency, in E3's scenario. In their analysis, energy efficiency must continue to improve at a steady and aggressive pace. Efficiency is valuable enough in its own right as a GHG reduction resource, but according to the study, electric energy efficiency, combined with better load management, will be critical to the feasibility of the decarbonization goal. Without aggressive demand reductions, it is doubtful that we can build all the low-carbon generation and

transmission infrastructure that we'll need by 2050, certainly not at an acceptable cost.

Despite the improvements in electric energy efficiency, E3 projects a doubling of total generation to serve California load. Why does electricity production need to double? Because not only must electricity continue to serve the end uses it currently serves, and for a much larger population, it must also displace direct fuel use for other purposes. This brings me to the third major measure – electrification.

In E3's scenario, transportation accounts for the vast majority of emission reductions in the electrification category. While I think it's unlikely that there will be enough electric vehicles on the road by 2020 to make much impact on emissions, the Commission is making a concerted effort to pave the way for much wider adoption in the future. One obstacle to customer acceptance of electric vehicles is the lack of charging infrastructure, and investors are reluctant to build the infrastructure without a large user base to support it. I'm delighted to share some recently breaking news on this topic. One week ago today, the Commission approved a settlement with NRG that resolves overcharges from the electricity crisis. Under

the terms of the settlement NRG will spend $102.5 million to deploy 200 DC fast chargers in our large urban areas and install 10,000 "level 2," or 240 volt charging panels at 1,000 or more multitenant residential buildings and workplaces at no cost to the building owners. By installing thousands of home, workplace and public charging stations, this creative settlement will really help facilitate the use of electric vehicles.

Some key issues remain unresolved. E3's scenario emphasizes the importance of managing electric vehicle charging to optimize the capacity utilization of the electric grid. In their analysis, ensuring that most charging occurs off-peak is essential to avoid expensive grid upgrades while total electricity demand grows.

To conclude, I hope that I have given you a sense of the accomplishments of the PUC and California's investor-owned utilities over the last ten years and some assurance that we're on track to meet the 2020 renewable energy and GHG goals. We are also beginning to lay the groundwork for reaching the long-term reductions that we'll need to avoid catastrophic climate change.

In all this, and in the efforts of the ARB, CEC, our research universities and national labs, the quest must be for more technological innovation.

We must never adopt a "penny wise, pound foolish" attitude that would thwart reaching the goals we know are critical to building a sustainable state, country and planet. We have the capability to transform our lives. Let's do it.